

FORM PTO-1390 (REV 10-94)		U.S. Dept. of Commerce and Patent and Trademark Office	ATTORNEY'S DOCKET NUMBER: N48.2-9735
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371			U.S. APPLICATION NO. 097830253
INTERNATIONAL APPLICATION NO.: PCT/FR00/00018	INTERNATIONAL FILING DATE (dd/mm/yy): 06/01/2000	PRIORITY DATE CLAIMED (dd/mm/yy): 05/02/1999	
TITLE OF INVENTION: Method For Making Electronic Modules With Ball Connector Or With Integrated Preforms Capable Of Being Soldered On A Printed Circuit And Implementing Device			
APPLICANT(S) FOR DO/EO/US: Francis Bourrieres, et al			
Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:			
<ol style="list-style-type: none"> <li>1. <input checked="" type="checkbox"/> This is a <b>FIRST</b> submission of items concerning a filing under 35 U.S.C. 371.</li> <li>2. <input type="checkbox"/> This is a <b>SECOND</b> or <b>SUBSEQUENT</b> submission of items concerning a filing under 35 U.S.C. 371.</li> <li>3. <input checked="" type="checkbox"/> This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).</li> <li>4. <input type="checkbox"/> A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.</li> <li>5. <input checked="" type="checkbox"/> A copy of the International Application as filed (35 U.S.C. 371(c)(2))               <ol style="list-style-type: none"> <li>a. <input type="checkbox"/> is transmitted herewith (required only if not transmitted by the International Bureau).</li> <li>b. <input checked="" type="checkbox"/> has been transmitted by the International Bureau.</li> <li>c. <input type="checkbox"/> is not required, as the application was filed in the United States receiving Office (RO/US).</li> </ol> </li> <li>6. <input checked="" type="checkbox"/> A translation of the International Application into English (35 U.S.C. 371 (c)(2)).</li> <li>7. <input checked="" type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))               <ol style="list-style-type: none"> <li>a. <input type="checkbox"/> are transmitted herewith (required only if not transmitted by the International Bureau).</li> <li>b. <input type="checkbox"/> have been transmitted by the International Bureau.</li> <li>c. <input type="checkbox"/> have not been made; however, the time limit for making such amendments has NOT expired.</li> <li>d. <input checked="" type="checkbox"/> have not been made and will not be made.</li> </ol> </li> <li>8. <input type="checkbox"/> A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).</li> <li>9. <input checked="" type="checkbox"/> An oath or declaration of the inventor (35 U.S.C. 371(c)(4)).</li> <li>10. <input type="checkbox"/> A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).</li> </ol>			
<b>Items 11. to 16. below concern other document(s) or information included:</b>			
<ol style="list-style-type: none"> <li>11. <input type="checkbox"/> An Information Disclosure Statement under 37 CFR 1.97 and 1.98.</li> <li>12. <input checked="" type="checkbox"/> An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.29 and 3.31 is included.</li> <li>13. <input checked="" type="checkbox"/> A <b>FIRST</b> preliminary amendment. Please enter the amendment before fee calculation. <input type="checkbox"/> A <b>SECOND</b> or <b>SUBSEQUENT</b> preliminary amendment.</li> <li>14. <input type="checkbox"/> A substitute specification.</li> <li>15. <input checked="" type="checkbox"/> A change of power of attorney and/or address letter.</li> <li>16. <input checked="" type="checkbox"/> Other items or information: VERIFIED STATEMENT CLAIMING SMALL ENTITY STATUS (1 pg) POSTCARD (1 pg) CONSTRUCTIVE PETITION (1 pg) CORRESPONDENCE ADDRESS NOTICE (1 pg)</li> </ol>			

17. ☒ The following fees are submitted:

**BASIC NATIONAL FEE (37 CFR 1.492(A)(1)-(5)):**

(select the appropriate one of the following fees)

Search Report has been prepared by the EPO or IPO ..... \$ 930.00

International preliminary examination fee paid to

USPTO (37 CFR 1.482) ..... \$ 490.00

No international preliminary examination fee paid to USPTO

(37 CFR 1.482) but international search fee paid to

USPTO (37 CFR 1.445(a)(2)) ..... \$ 750.00

Neither international preliminary examination fee (37 CFR

1.482) nor international search fee (37 CFR

1.445(a)(2)) paid to USPTO ..... \$ 1,070.00

International preliminary examination fee paid to USPTO

(37 CFR 1.482) and all claims satisfied provisions

of PCT Articles 33(2)-33(4) ..... \$ 98.00

\$ 930.00

**ENTER APPROPRIATE BASIC FEE AMOUNT =**

Surcharge of \$130.00 for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(e)).

\$

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE	
Total Claims	9 - 20 =	0	x \$ 22.00	\$
Independent Claims	2 - 3 =	0	x \$ 82.00	\$

Multiple Dependent Claims (if applicable)

+ \$ 270.00

\$

**TOTAL OF ABOVE CALCULATIONS =** \$930.00

Reduction by 1/2 for filing by small entity, if applicable. Verified Small Entity Statement must be filed also. (Note 37 CFR 1.9, 1.27, 1.28).

\$465.00

**SUBTOTAL =** \$465.00

Processing fee of \$130.00 for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(f)).

\$

**TOTAL NATIONAL FEE =** \$465.00

Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). \$40.00 per property

\$40.00

**TOTAL FEES ENCLOSED =** \$505.00

Amount to be: Refunded \$

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- a. ☒ A check in the amount of \$505.00 to cover the above fees is enclosed.
- b. ☐ Please charge my Deposit Account No. \_\_\_\_\_ in the amount of \$\_\_\_\_\_ to cover the above fees is enclosed. A duplicate copy of this sheet is enclosed.
- c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 22-0350.

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## PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE  
UNITED STATES RECEIVING OFFICE (RO/US)

<b>In re Application of:</b>	Francis Bourrieres, et al
<b>U.S. Nat'l Stage of Int'l App. No.:</b>	PCT/FR00/00018
<b>Int'l Filing Date:</b>	6 January 2000
<b>For:</b>	Method For Making Electronic Modules With Ball Connector Or With Integrated Preforms Capable Of Being Soldered On A Printed Circuit And Implementing Device

Box PCT

ATTN: EO/US

Commissioner for Patents  
Washington, D.C. 20231

Docket No.: N48.2-9735

## PRELIMINARY AMENDMENT

Before calculating the fees in this application, please amend the above-identified application as indicated below:

In the Abstract:

Insert the abstract page 19, enclosed herewith.

In the Claims:

Replace original claims 1-9 with claims 1-9 as follows:

- 1) (Amended) Method for producing an electronic module in the shape of a ball housing combining a network of balls (7) or geometrically identical preform connectors or shield system and surface-mounted components (2) on the same side of a substrate (1), thus making this module directly connectable by soldering to a printed circuit (3), wherein soldering cream (8) is deposited simultaneously for the components and the connecting ball or shield system located on the same surface;  
said components are transferred onto the corresponding mounting lands;  
the ball connectors with a diameter greater than the height of said components are transferred collectively onto the lands of the same side intended for them by an appropriate device; and  
a single re-melting cycle permits simultaneous soldering of the components and the connecting balls or shields onto the substrate.

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- 2) (Unchanged) Method as claimed in claim 1, wherein the soldering cream (8) is deposited via serigraphy.
- 3) (Unchanged) Method as claimed in claim 1, wherein the soldering cream (8) is deposited by syringe.
- 4) (Amended) Method as claimed in claim 1, wherein it makes it possible to produce an electromagnetic shield (18) integrated directly into the electronic module by conducting connections (19)(21) to the layout (20) of the circuit (3).
- 5) (Amended) Method as claimed in claim 1, wherein it makes it possible to integrate as close to the connecting balls (7) as possible and on the same side of the electronic module by-pass capacitors (17) and/or series resistors (16) and/or filtering cells and/or quartz adapter condensers.
- 6) (Amended) Method as claimed in claim 1, wherein the side of the module opposite the side comprising the balls and the components allows gripping of the module by suction.
- 7) (Amended) Gripping and collective transfer device (9) for balls (7) or geometrically identical preforms, wherein the device has a working face (11) whose configuration is adapted to the dimensions and to the volume of the balls or preforms to be gripped and makes it possible to avoid any contact with the electronic components (2) or any other obstacle that might be present on the surface (12) of the substrate (1).
- 8) (Unchanged) Device as claimed in claim 7, wherein the gripping device (9) is equipped with a vacuum chamber (13) into which open all of the orifices for holding the balls or preforms (7) in order to seize and place all of said balls simultaneously.
- 9) (Unchanged) Device as claimed in claim 7, wherein the working face (11) of the gripping device (9) defining the face for holding the balls or preforms (7) is adapted to the dimensions of these balls or preforms and to the shape of the receiver substrate (12).

Application of: *Bourrieres, et al*  
Int'l App. No.: *PCT/FR00/00018*  
Int'l Filing Date: *6 January 2000*

*Preliminary Amendment*

*Page 3*

### REMARKS


The amendment removes multiple dependencies and makes other formal changes to the language as indicated on the attached marked copy of the claims. No new matter has been added. The Abstract inserted herewith is the English language abstract published with the application as WO 00/47047.

Respectfully submitted,

VIDAS, ARRETT & STEINKRAUS

Date: April 23, 2001

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**Marked up copies of claims showing changes made by preliminary Amendment**

- 1) (Amended) Method for producing an electronic module in the shape of a ball housing combining a network of balls (7) or geometrically identical preform connectors or shield system and surface- mounted components (2) on the same side of a substrate (1), thus making this module directly connectable by soldering to a printed circuit (3), wherein soldering cream (8) is deposited simultaneously for the components and the connecting ball or shield system located on the same surface ~~and wherein~~;  
said components are transferred onto the corresponding mounting lands ~~and wherein~~;  
the ball connectors with a diameter greater than the height of said components are transferred collectively onto the lands of the same side intended for them by an appropriate device; ~~and wherein~~  
a single re-melting cycle permits simultaneous soldering of the components and the connecting balls or shields onto the substrate.
- 2) Method as claimed in claim 1, wherein the soldering cream (8) is deposited via serigraphy.
- 3) Method as claimed in claim 1, wherein the soldering cream (8) is deposited by syringe.
- 4) (Amended) Method as claimed in claims 1 ~~to 3~~, wherein it makes it possible to produce an electromagnetic shield (18) integrated directly into the electronic module by conducting connections (19)(21) to the layout (20) of the circuit (3).
- 5) (Amended) Method as claimed in claims 1 ~~to 3~~, wherein it makes it possible to integrate as close to the connecting balls (7) as possible and on the same side of the electronic module by-pass capacitors (17) and/or series resistors (16) and/or filtering cells and/or quartz adapter condensers.
- 6) (Amended) Method as claimed in claims 1 ~~to 5~~, wherein the side of the module opposite the side comprising the balls and the components allows gripping of the module by suction.
- 7) (Amended) Gripping and collective transfer device (9) for balls (7) or geometrically identical preforms, wherein it ~~the device~~ has a working face (11) whose configuration is adapted to the dimensions and to the volume of the balls or preforms to be gripped and makes it possible to avoid any contact with the electronic components (2) or any other obstacle that might be present on the surface (12) of the substrate (1).
- 8) Device as claimed in claim 7, wherein the gripping device (9) is equipped with a vacuum chamber (13) into which open all of the orifices for holding the balls or preforms (7) in order to seize and place all of said balls simultaneously.

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9) Device as claimed in claim 7, wherein the working face (11) of the gripping device (9) defining the face for holding the balls or preforms (7) is adapted to the dimensions of these balls or preforms and to the shape of the receiver substrate (12).

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~~METHOD FOR MAKING ELECTRONIC MODULES WITH BALL CONNECTOR OR WITH  
INTEGRATED PREFORMS CAPABLE OF BEING SOLDERED ON A PRINTED CIRCUIT  
AND IMPLEMENTING DEVICE~~

This invention regards a method for producing electronic modules that include surface-mounted components as well as connecting balls or preforms on the same surface of a substrate.

Electronic modules are used with increasing frequency because they offer numerous advantages. For example, they make it possible to increase the component density and thus to include more functionalities in an identical volume. They also make it possible to reduce the number of components to be transferred to the final assembly of electronic cards and to thereby reduce the opportunities for defects, since the module can be assembled and tested separately, then used as a component in the card.

Traditionally, electronic modules are produced by mounting surface components called SMCs on a ceramic or glass epoxy substrate. Then, to connect the module thus produced to the electronic card that is to receive it, several techniques can be used. For example, pins soldered onto the substrate in flat position allow the interconnection of the module perpendicularly to another electronic module by inserting the free part of these pins through holes in this electronic card; the module can then be wave-soldered or, if required, reworked manually.

These modules have several disadvantages such as, for example, a high manufacturing and implementation cost, for, on the one hand, the positioning of the pins is difficult to be automated and, on the other hand, the pins must be inserted into the holes by hand, for modules inserted vertically are not conducive to the automatic suction gripping usually used for SMCs. Furthermore, these modules do not allow very high densities given the limited number of interconnection pins. Finally, the size of these modules is not very compatible with the miniaturization requirements of modern electronics.

Another mode of manufacturing of electronic modules consists in placing a female connector on the module and a male connector on the receiver card



of the module. In this case as well, the module must be positioned by hand, and the cost of these connectors is still high.

Another method for producing electronic modules according to the prior art consists in placing the SMCs on the top surface of a ceramic or glass epoxy substrate and producing the interconnections on the other side by positioning and soldering balls there. This module may then be transferred and soldered onto an electronic card in the same way as a standard ball component. The production price for this type of module is still high, for production of the balls is an additional operation. Furthermore, suction gripping can sometimes be difficult to use because the components on the top part can obstruct the movement of the gripping device.

Patents US5838545 and US5675183 claim an electronic module comprising on its top face a radiator and on its bottom face integrated circuits in the middle of interconnection elements that make it possible to connect the module to another level. These patents do not give any information concerning the method for producing this type of electronic module.

Specifically, we shall see in the description that follows that this invention is a method that permits to produce of electronic modules of this type at a lower cost than the prior art as it is known in these patents.

Patents US5570274 and US5027191 describe other electronic modules for which the interconnection elements between the module and the printed circuit that receives this module are on a different plane than the one comprising the electronic components. To produce this offsetting between planes, either a cavity is produced into which the components are transferred or a positioning spacer is inserted to allow the stacking on top of each other of the interconnecting elements. In these cases, again, this invention provides a solution that makes it possible to produce these modules more easily and therefore at a lower cost.

The method targeted by this invention makes it possible to eliminate the problems of the prior art, but also resolves a few other problems as well, as will become clear in what follows.

The method for producing an electronic module according to the invention is characterized in that:

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- the substrate used comprises on the same face mounting lands adapted to the surface-mounted components, ensuring the electronic function of the module, and also to the balls, ensuring the electrical and mechanical connections between the module and the printed circuit that is to receive this module,
- in a single and same operation, a soldering cream is deposited onto said mounting lands corresponding to the SMCs, as well as to those corresponding to the interconnection balls or preforms. The soldering cream depositing process via serigraphy is specially adapted to accomplish this deposit simultaneously on the lands of the SMCs and the balls, but this soldering cream may also be deposited using a syringe.
- said connecting balls, generally made of high-temperature lead-tin such as, for example a 90% lead/10% tin alloy, have a diameter greater than the height of the tallest electronic component making up the module,
- said surface-mounted components and said interconnection balls are transferred one after another onto the deposits of soldering cream made previously on the substrate of the module,
- said balls are transferred at the same time like a SMC component using an adapted gripping device,
- a temperature cycle allows the soldering cream to reflow in order to solder both said SMCs and also the connecting balls,
- the module thus produced can be connected directly to a printed circuit like any other component with connecting balls.

Since the electronic components and balls are on the same side of the substrate, the connecting elements are produced in the same operation as the electronic function of the module, which makes it possible to produce the interconnection function at a price of around one centime per connection, while according to the prior art the price was easily 10 centimes per connection.

Furthermore, as the electronic components are arranged on the same side as the connecting balls, the other side is therefore free to allow gripping of the module by suction, just like any other surface-mounted component.

Additionally, by arranging the connecting balls around the perimeter of the electronic components and in several rows, if necessary, which appreciably increases the potential interconnection density and by providing

a ground plane on the substrate, which may naturally be multi-layered, it is possible to produce an electromagnetic shield for the module without any additional operations, while these shields are normally produced by adding a metal cap onto the components likely to emit or to be sensitive to electromagnetic radiation. These caps are particularly disruptive to the manufacturing process for electronic cards, since they are not only additional parts, but are also difficult to solder.

This method can also make it possible to produce ball housings with low electromagnetic pollution. It is thus possible to integrate electronic components such as decoupling capacitors during the same work phase as the BGA balling operation. With the widespread use of rapid logic circuits, the filtering of power sources and inputs/outputs of large integrated circuits presents a problem not satisfactorily resolved until now. Effectively, the numerous connections that converge toward the housing leave only a small space for setting filtering elements. These filtering elements are therefore located far from the housing, and problems of electromagnetic compatibility then appear:

- electromagnetic radiation from clock pulses and rapid signals,
- susceptibility to external radiation, with system malfunctions.

Given the requirement of the EC standards, these problems are no longer acceptable today and are resolved by installing shields. However, shield installation is a costly operation that requires skills that are not always available. Experience shows that in many cases, it would suffice to reduce the radiation by ten or fifteen decibels to achieve compliance with the standards. Our solution provides an improvement of this magnitude, and thus very often allows the designer to do without shielding. This new ball housing system provides an optimized solution to the problems of electromagnetic compatibility by allowing components to be installed near the integrated circuit chip. More precisely, this housing allows the installation of components on its bottom side, among the connecting balls.

One will easily understand the interest of placing the decoupling capacitors, for example, between the positive of the power feed ball and the grounding ball: the current impulses remain localized in a very short circuit, which greatly reduces electromagnetic radiation and pollution of the card.

Some inputs are susceptible of being disturbed by R.F. signals and, as a result, require that these signals be filtered. These include, for example, analog inputs of analog/digital converters or low level analog inputs. With the advent of low voltage logic circuits, R.F. disturbances may even affect logic inputs. Our system will allow the fitting of a filtering unit directly on the housing among the balls. The reduced size of this circuit will protect it from disruptive radiation, particularly radiation from EC standard compatibility testing.

- figures 1 and 2 illustrate electronic modules according to the prior art,
- figure 3 shows an electronic module produced according to this invention,
- figure 4 shows the production sequence for a module according to the invention
- figure 5 shows a gripping device adapted to the invention,
- figure 6 shows another gripping device according to the invention, adapted to a three-dimensional circuit.

- figure 7 illustrates the type of module that can be produced thanks to the invention.

- figure 8 is a schematic representation of a BGA with its connecting balls

and related Surface Mounted Components,

- figure 9 shows a bare ball circuit without components (no chips or SMC) with a single shielding function,

- figure 10 represents a ball circuit that is a module that accomplishes a function and acts as a shield at the same time.

**Abstract** The purpose of this study was to determine the effect of a 12-week training program on the heart rate (HR) and blood pressure (BP) of sedentary, middle-aged men. The subjects were divided into two groups: a control group and an exercise group. The control group consisted of 10 men who did not exercise, and the exercise group consisted of 10 men who exercised for 12 weeks. The HR and BP were measured at baseline and at the end of the 12-week period. The results showed that the exercise group had a significant decrease in both HR and BP compared to the control group. The HR decreased from 72 to 68 beats per minute, and the BP decreased from 120/80 to 110/70 mmHg. These findings suggest that a 12-week training program can effectively reduce HR and BP in sedentary, middle-aged men.

Figure 1 represents an electronic module of the prior art consisting of a substrate (1), components (2) and a female connector (4) that is connected to a printed circuit (3) by a male connector (5). In this example, it is therefore necessary to solder a male connector onto the module and a female connector onto the printed circuit, which, added to the price of the connector, makes this technique very expensive. Additionally, in order to reduce the number of connectors, this technique requires the designer of the card and of the module to lead all the inputs and all the outputs to the same spot, which creates space and product design constraints.

Figure 2 shows a cross-sectional view of another electronic module of the prior art consisting of a substrate (1) and components (2) and that is connected to the printed circuit (3) by balls (7). In this case, the installation of balls on the module is done after the substrate is equipped with electronic components and therefore requires the depositing of additional soldering cream on the substrate, transferring balls onto the deposits of cream, and requires a second re-melting operation in order to solder the balls onto the substrate. This solution, although interesting from the standpoint of the component density it allows, remains costly and therefore difficult to generalize for widely disseminated products.

Figure 3 shows a cross-sectional view of a module produced according to this invention. The balls (7) and components (2) are, in this case, transferred onto the same face of the substrate (1). Interconnection with the printed circuit (3) is therefore accomplished by balls (7) that have a sufficient diameter to make it possible to place the components between the substrate (1) and the printed circuit (3) without any mechanical interference.

Figure 4 illustrates the production sequence for an electronic module according to this invention. First, soldering cream (8) is deposited via serigraphy onto the mounting lands related to the electronic components and to the balls of the substrate (1). Then one transfers electronic components (2) onto the substrate using known means, followed by the gripping and collective transfer of the balls (7) thanks to the gripping device (9). Finally, the soldering cream is reflowed, which permits soldering of the electronic components and the balls simultaneously onto the

substrate. It should be noted that it is possible to reverse the order for transferring the components and the balls without challenging this invention.

The method according to this invention is therefore a means of producing electronic modules that are particularly inexpensive and that furthermore can have shielding features without requiring the addition of supplementary parts. The device targeted by patent application FR98.13424 by the same inventor is particularly suited to making connecting balls available in order to transfer them simultaneously using a gripping device. Furthermore, for enhanced facility, the gripping device may be chamfered opposite the surface components in order to prevent any interference between the components present on the module at the time the balls are transferred.

It should also be noted that it is conceivable to transfer chips, in addition to the SMC devices, directly onto the electronic module either on the same side as the connector balls and/or on the other side.

To further increase the component density on the module, surface-mounted components soldered at the same time as the connecting balls or other elements may be transferred onto the side opposite the side comprising the connecting balls.

To implement said method, it is necessary to get away from the size constraints linked to components that are as different as surface-mounted components or even to obstacles that could be present on the surface of the substrate and the connecting balls or preforms. In the production process, it is preferable to position the electronic components first and then the balls or preforms, since these balls or preforms have a very small contact surface and while their hold on the soldering cream is admittedly sufficient in static state, as soon as motion is applied with accelerations, as is the case during transfer onto the component installation machines, the balls are in danger of shifting and of moving off their mounting land. In order to get around this disadvantage, a device used for gripping and for transferring the balls or preforms has a working face whose configuration is adapted to the dimensions and to the shapes of the balls or preforms to be gripped in order to avoid any contact with the electronic components or any other obstacle that might be present on the surface of the substrate and already in place when said balls are positioned.

According to a preferred mode of embodiment of the gripping or transfer device shown in figure 5, the gripping device has a working face (11) parallel to the face (12) of the substrate (1) to be equipped. This working face (11) has been spot-faced so as not to interfere with the components during application of the balls. On this working face there are suction and holding holes for all the balls or preforms. The holes communicate with a vacuum chamber (13), which itself communicates with a vacuum generator (14). Thus when suction is applied by the vacuum generator, the balls (7) are sucked up and held in this position. The gripping device may then be placed opposite the substrate already equipped with surface-mounted electronic components. The gripping device is lowered vertically until the balls come into contact with the substrate; the suction is cut off, and the gripping device can then be lifted.

According to another feature, the gripping device according to the invention and pursuant to the method is equipped with orifices for gripping and transferring balls or preforms in accordance with the intervals between balls. These are generally constant for a same circuit, but it is possible to imagine different intervals.

According to another feature of the device according to the invention, it is possible to install balls or preforms on different planes or levels; these balls or preforms may also have different diameters or shapes; in this case, the configuration of the working face if the gripping device is adapted both to the configuration of the printed circuit, which may be three-dimensional, and the side defined by the lower part of the balls or preforms. In all cases the sides between the surface of the substrate and the side defined by the lower part of the balls or preforms are parallel.

According to another feature, the device according to the invention may have a known system for supplying balls or preforms; this may be a reservoir where the balls and preforms are all identical but stored loose, which can be a device such as the one targeted by patent application FR98.13424 by the same inventor.

In figure 6, we see a three-dimensional molded circuit (15). The gripping device (9) equipped with a vacuum chamber (13) has a three-dimensional working face (11) and an adapted configuration. This is an additional example of what it is possible to produce using this invention.

Figure 7 represents an example of an electronic module that can be produced as a result of this invention. The balls (7) and components (2) can be arranged over the entire surface of the module as the designer sees fit. Thus, it becomes possible to achieve very high densities, and the designer of electronic products can optimize his product.

Figure 8 shows the component location on the ball circuit; of course, it will be possible to provide component locations even if they are not established, the location being open to configuration based on needs. (17) is a decoupling capacitor between two balls and (16) refers to serial resistors with the outputs.

By placing the balls over the entire periphery of the housing, we can produce a Faraday cage whose height is equal to the diameter of the balls. It will suffice for that to create two ground planes (a lower ground plane and an upper ground plane) connected electrically to one another by balls that therefore become shielding balls distinct from connecting balls that allow the electrical connection of the components of the electronic module to the printed circuit that receives the module. Many configurations are possible, depending on the sides on which these conductor layouts are arranged. First example, in figure 9: the ball circuit serves solely as a shield. A conductive plane (18) is arranged on the upper face of the ball circuit; conducting feed-throughs (19) connect the balls to this plane. The components to be shielded are arranged on the main circuit (3). The lower face of the main circuit constitutes the lower conductive plane (20), which is also connected to the balls (7) by conducting feed-throughs (21). Second example, in figure 10: the ball circuit is itself a module with a function (oscillator, R.F. amplifier, R.F. filter, etc.); in this case, the lower conductive plane (20) is situated above the printed circuit (3) and the conducting feed-throughs (21) make it possible to lead the electrical signals back to the lower face of the printed circuit (3). It comprises components on its lower face. In all these configurations, connecting balls are part of the shield. The distance between each ball will, of course, have an influence on the effectiveness of this shield, since the interval between each shield ball is a hole in said shield. For balls two millimeters in diameter and spaced four millimeters apart, we obtain a shield that is already highly effective even beyond the Gigahertz range. It is especially important that each shielding ball



have its own contact feed-through to the lower and upper conductor planes. The height of the components that may be enclosed depends on the diameter of the balls.

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## CLAIMS

1) Method for producing an electronic module in the shape of a ball housing combining a network of interconnection or shielding balls (7) or geometrically identical preforms and surface-mounted components (2) on the same side of a substrate (1), thus making this module directly connectable by soldering to a printed circuit (3), wherein soldering cream (8) is deposited simultaneously for the components and the interconnection or shielding balls located on the same surface and wherein the said components are transferred onto the corresponding mounting lands and wherein the interconnection balls with a diameter greater than the height of said components are transferred collectively onto the lands of the same side intended for them by an appropriate device and wherein a single reflow cycle permits simultaneous soldering of the components and the interconnection or shielding balls onto the substrate.

2) Method as claimed in claim 1, wherein the soldering cream (8) is deposited via serigraphy.

3) Method as claimed in claim 1, wherein the soldering cream (8) is deposited by syringe.

4) Method as claimed in claims 1 to 3, wherein it makes it possible to produce an electromagnetic shield (18) integrated directly into the electronic module by conducting connections (19)(21) to the ground plane (20) of the circuit (3).

5) Method as claimed in claims 1 to 3, wherein it makes it possible to integrate as close to the connecting balls (7) as possible and on the same side of the electronic module decoupling capacitors (17) and/or serial resistors (16) and/or filtering cells and/or quartz adapter condensers.

6) Method as claimed in claims 1 to 5, wherein the side of the module opposite the side comprising the balls and the components allows gripping of the module by suction.

7) Gripping and collective transfer device (9) for balls (7) or geometrically identical preforms, wherein it has a working face (11) whose configuration is adapted to the dimensions and to the volume of the balls or preforms to be gripped and makes it possible to avoid any contact with

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the electronic components (2) or any other obstacle that might be present on the surface (12) of the substrate (1).

8) Device as claimed in claim 7, wherein the gripping device (9) is equipped with a vacuum chamber (13) into which open all of the orifices for holding the balls or preforms (7) in order to seize and place all of said balls simultaneously.

9) Device as claimed in claim 7, wherein the working face (11) of the gripping device (9) defining the face for holding the balls or preforms (7) is adapted to the dimensions of these balls or preforms and to the shape of the receiver substrate (12).

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**METHOD FOR MAKING ELECTRONIC MODULES WITH BALL CONNECTOR  
OR WITH INTEGRATED PREFORMS CAPABLE OF BEING SOLDERED ON A  
PRINTED CIRCUIT AND IMPLEMENTING DEVICE**

**ABSTRACT**

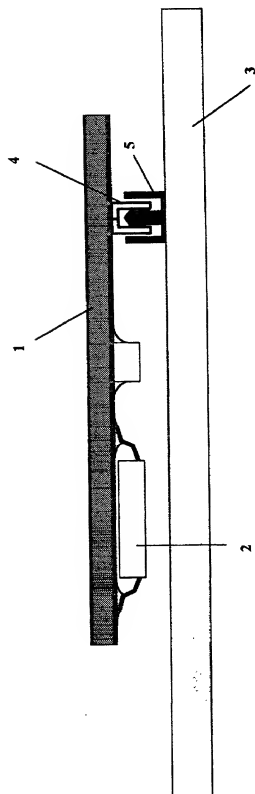
The invention concerns a method for producing electronic modules with ball connector (7) or integrated preforms capable of being soldered on a printed circuit (3) and a device for implementing said method. The invention concerns a method for producing electronic modules in the form of ball housings combining a ball grid array (7) or geometrically identical preforms for interconnecting or shielding and surface-mounted components (2) on the same surface of a substrate (1), thereby enabling said module to be directly connectable by soldering on a printed circuit (3). The balls (7) and the components (2) are transferred in one single step onto the substrate (1) by means of a gripping device adapted to the topography of the module to be produced.

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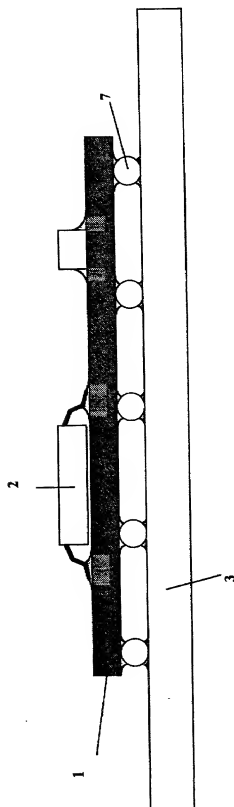
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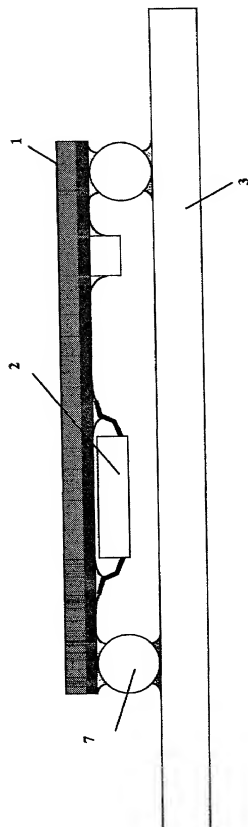
Fig. 2

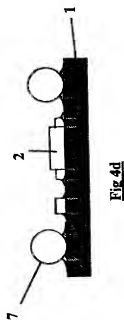
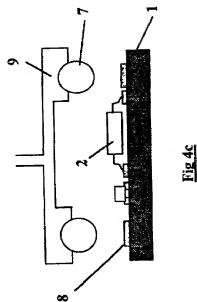
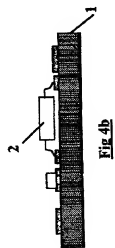
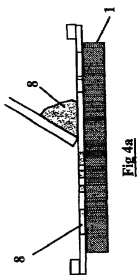
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Fig. 3

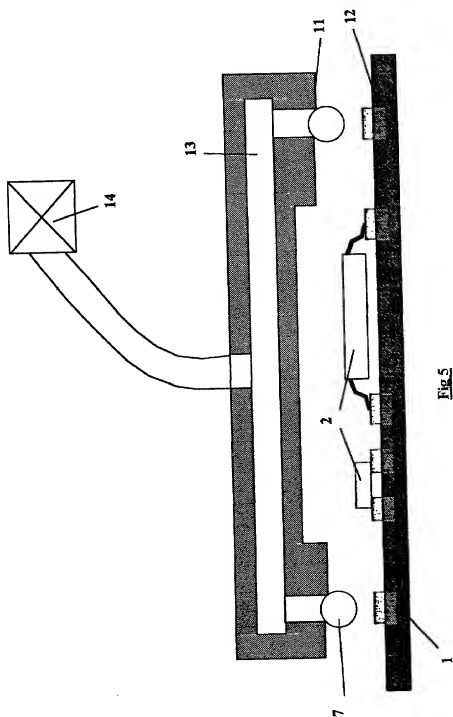




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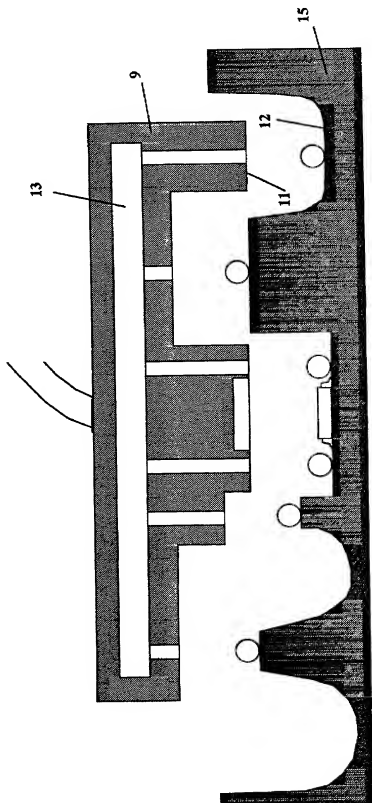
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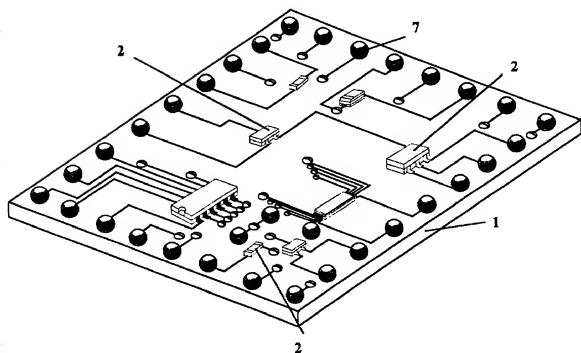
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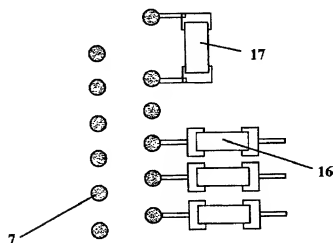


**Fig 6**

Fig 7

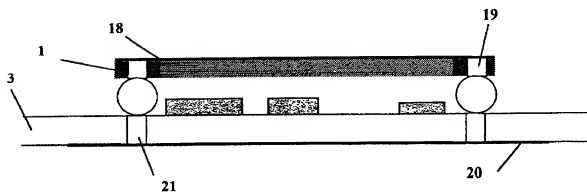
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**Fig 8**

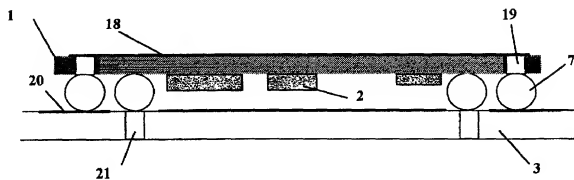
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**Fig 9**

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Fig 10

## UTILITY/DESIGN PATENT

## IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

<b>Inventor(s):</b>	Francis Bourrieres, et al
<b>Title:</b>	Method For Making Electronic Modules With Ball Connector Or With Integrated Preforms Capable Of Being Soldered On A Printed Circuit And Implementing Device
<b>Filed:</b>	<input checked="" type="checkbox"/> concurrently herewith <input type="checkbox"/> on _____ and assigned Serial No. _____

Commissioner for Patents  
Washington, DC 20231

Docket No: N48.2-9735

## POWER OF ATTORNEY FROM ASSIGNEE

As assignee of record of the entire interest of the above identified patent application, Societe Novatec S.A. hereby appoint all practitioners of Customer No. 490 to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith. I hereby authorize them to act and rely on instructions from, and to communicate directly with, the firm or person which sent this case to Vidas, Arrett & Steinkraus, P.A., unless or until I instruct Vidas, Arrett & Steinkraus P.A., in writing to the contrary.

Address all correspondence to **Walter J. Steinkraus** at Customer Number 490.

Dated this 27 day of March, 2001.

(Company Name)

Societe Novatec S.A.

(Signature)

By: 

(Typed name)

Francis Bourrieres

(Title)

Its:

President

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## DECLARATION

As a below-named inventor, I(we) hereby declare that:

### TYPE OF DECLARATION

This declaration is of the following type:

- ☐ original
- ☐ design
- ☐ supplemental
- ☒ national stage of PCT
- ☐ divisional
- ☐ continuation
- ☐ continuation-in-part (CIP)

### INVENTORSHIP DECLARATION

My residence, post office address, and citizenship are as stated below next to my name;

I verily believe I am the original, first and sole inventor (*if only one name is listed below*) or an original, first and joint inventor (*if plural names are listed below*) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

**Method For Making Electronic Modules With Ball Connector Or With Integrated Preforms Capable Of Being Soldered On A Printed Circuit And Implementing Device**

the specification of which:

- a) ☐ is being filed concurrently herewith
- b) ☐ was filed on \_\_\_\_\_ and assigned Serial No. \_\_\_\_\_
- c) ☒ was filed as PCT International Application No. PCT/FR00/00018 filed on 1/6/2000 and amended under PCT Article 19 on \_\_\_\_\_.

### ACKNOWLEDGMENT OF REVIEW OF PAPERS AND DUTY OF CANDOR

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations §1.56.

- ☐ In compliance with this duty there is attached an Information Disclosure Statement.  
37 CFR 1.97.

### PRIORITY CLAIM

I hereby claim foreign priority benefits under Title 35, United States Code, §119(a)-(d), of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me having the same subject matter having a filing date before that of the application on which priority is claimed.



COUNTRY	APPLICATION NUMBER	DATE OF FILING (day, month, year)	PRIORITY CLAIMED UNDER 37 USC 119
FR	99/01390	05/02/1999	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO
			<input type="checkbox"/> YES <input type="checkbox"/> NO
			<input type="checkbox"/> YES <input type="checkbox"/> NO
			<input type="checkbox"/> YES <input type="checkbox"/> NO

I hereby claim the benefit under Title 35 United States Code, §119(e) of any United States provisional application identified below.

U.S. APPLICATIONS	
APPLICATION NUMBER	U.S. FILING DATE
1.	
2.	

#### CLAIM FOR BENEFIT OF EARLIER U.S./PCT APPLICATIONS(S) UNDER 35 U.S.C. §120

I hereby claim the benefit under Title 35, United States Code, §120 of any United States applications(s) or PCT international applications(s) designating the United States of America that is/are listed below.

U.S. APPLICATIONS	
APPLICATION NUMBER	U.S. FILING DATE
1.	
2.	
PCT APPLICATIONS DESIGNATING THE U.S.	
PCT APPLICATION NO.	PCT FILING DATE
3.	

I hereby declare that all statements made herein of my knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Telephone calls and correspondence should be directed to: Walter J. Steinkraus, at Customer No. 490. Telephone: (952) 563-3000. Facsimile: (952) 563-3001.

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**Francis Bourrieres**

Inventor's signature

Date:

**27 MARCH 2001**

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Residence.

(If different than above)

**Second Inventor**

Full name

**Clement Kaiser**

Inventor's signature

Date

**MARCH 27 2001**

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Residence

(If different than above)

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## IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s):	Francis Bourrieres; Clement Kaiser
Title:	Method For Making Electronic Modules With Ball Connector Or With Integrated Preforms Capable Of Being Soldered On A Printed Circuit And Implementing Device
Filed:	<input checked="" type="checkbox"/> concurrently herewith <input type="checkbox"/> on _____ and assigned Serial No. _____

Commissioner for Patents  
Washington, DC 20231

Docket No.: N48.2-9735

## VERIFIED STATEMENT CLAIMING SMALL ENTITY STATUS (ASSIGNEE FORM)

I, Francis Bourrieres, President of Societe Novatec S.A. which has its principal place of business at 350, avenue d'Italie, Z.A. Albasud, F-8200 Montrauban, France (hereinafter "the Company"), hereby state that:

1. I am empowered to act on behalf of the Company in making the following statements to establish status as a small entity under 37 C.F.R. §1.9.
2. By assignment of all right, title and interest in and to the invention identified above, the Company is the owner of the subject matter of the patent application identified above.
3. The Company has not assigned, granted, conveyed or licensed any rights in and to the invention, and is not under any obligation, contract or law to assign, grant, convey or license any rights to said invention to any other party.
4. The Company is a business concern which presently employs less than 500 persons.
5. Based upon the above facts, it is believed that the Company is a Small Business for paying reduced fees as set forth in 37 C.F.R. §1.9(d).
6. The Company acknowledges its duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate (37 C.F.R. §1.28(b)).
7. The Company hereby declares that all statements made herein of its own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

Dated this 27 day of MARCH, 2001.

(Company Name)

Societe Novatec S.A.

(Signature)

By: 

(typed name)

Francis Bourrieres

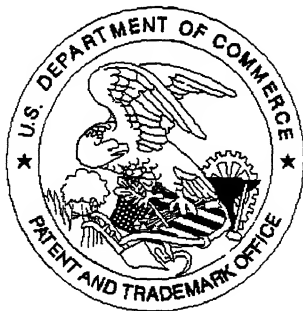
(title)

Its:

President

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United States Patent & Trademark Office  
Office of Initial Patent Examination -- Scanning Division



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